

**COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY  
SUBCOMMITTEE ON ENVIRONMENT  
U.S. HOUSE OF REPRESENTATIVES  
HEARING CHARTER**

*Coping with Compound Crises: Extreme Weather, Social Injustice, and a Global Pandemic*

Wednesday, September 30, 2020  
11:30 am ET  
Cisco WebEx

**PURPOSE**

This hearing is an opportunity to discuss challenges in communicating and responding to disasters due to compounding stressors such as climate change and the COVID-19 pandemic. The hearing will touch upon the impacts of these stressors to environmental justice communities; the role of social and behavioral sciences in risk communication of science-based messages related to these compound stressors; the gaps in emergency management research to inform preparation and response; and the public and human health impacts of dealing with disasters during a global pandemic.

**WITNESSES**

- **Dr. Roxane Cohen Silver**, *Professor of Psychological Science, Medicine, and Public Health, University of California, Irvine*
- **Ms. Colette Pichon Battle (PEA-SHOWN Battle)**, *Founder and Executive Director, Gulf Coast Center for Law and Policy (GCCLP)*
- **Dr. Samantha Montano (MON-TAN-NO)**, *Assistant Professor of Emergency Management, Massachusetts Maritime Academy*

**OVERARCHING QUESTIONS**

- How can social and behavioral sciences inform us about how people respond to compound events, such as a pandemic and a natural disaster, in order to improve preparedness?
- What are the gaps in research on disaster planning, mitigation, and response? How can federal R&D funding fill those gaps?
- How do individuals perceive risk and respond to warnings and other crisis communications?
- How are vulnerable communities and populations disproportionately impacted by the dual threat of extreme weather and a pandemic?
- Are there lessons learned from our national response to COVID-19 that can be applied to climate change, or vice-versa?

**BACKGROUND**

As of July 8<sup>th</sup>, there have been ten weather and climate disasters in 2020 that have cost over \$1 billion dollars each in the United States.<sup>1</sup> From January to June, these events caused 80 deaths and nearly \$18 billion in damages.<sup>2</sup> This does not include any of the wildfires that continue to ravage the Western United States and Alaska, the Midwest derecho that obliterated cornfields

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<sup>1</sup> <https://www.ncdc.noaa.gov/billions/>

<sup>2</sup> <https://www.nbcnews.com/science/environment/u-s-has-already-had-10-billion-dollar-disasters-year-n1233220>

across Iowa and other states, or the hurricanes that brought un-survivable levels of storm surge to the Gulf Coast. The United States is on pace to exceed the record of 16 billion-dollar disasters in a year, which has occurred twice before, in 2011 and 2017.<sup>3</sup>

This record year of weather and climate disasters comes as the United States is still grappling with the COVID-19 pandemic, with cases surging this summer in states at risk of extreme weather events.<sup>4</sup> Typically, those in the path of hurricanes, wildfires, floods, and other disasters are evacuated to group shelters. However, these evacuations could lead to widespread transmission of COVID-19 depending on how the evacuation is executed.<sup>5</sup> Accordingly, preparations for this year's disasters have looked different from those in years past. Emergency management officials have adapted to this new reality, rewriting emergency procedures to prevent the spread of COVID-19 in the wake of a disaster evacuation.<sup>6</sup>

Even with these new plans in place, there is no guarantee that when disaster strikes, they will be perfectly carried out. In the case of disasters that require evacuations, often these evacuations can be last minute and rushed. Strong winds pushed Oregon fires through dry trees and brush, causing “the blazes to explode in size and sending them rushing into towns and rural homes,” and forcing people to flee with little warning.<sup>7</sup> As tens of thousands have been forced to evacuate in the state, reports have surfaced of mask-less evacuees and challenges in enforcing social distancing rules.<sup>8</sup> Already, at least one person has tested positive for COVID-19 at a wildfire shelter in Linn County, Oregon.<sup>9</sup> Another two people tested positive in a temporary shelter in Seattle designed to protect those experiencing homelessness from poor air quality due to the fires.<sup>10</sup> As Oregon evacuates its state prisons, inmates are relocated to other correctional facilities around the state, where they are at increased risk of contracting COVID-19 due to overcrowding.<sup>12</sup> As evacuations from wildfires continue across the West, public health and safety problems due to the compounding effects of the pandemic and wildfires will continue for emergency managers and evacuees alike.

## **Cascading Risks and Compound Events**

### Extreme Weather and the COVID-19 Pandemic

Compound weather and climate events are defined as comprising of “multiple distinguishable physical drivers and/or hazards and their risks.”<sup>11</sup> They can be temporal (multiple storms in a row), spatial (simultaneous crop failures), or a concurrence of multiple variables (storm surge, flooding, and high winds from one storm).<sup>12</sup> The compound crises presented by extreme weather and climate events on top of the pandemic are presenting complex challenges for public health and disaster preparedness and response.

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<sup>3</sup> Ibid

<sup>4</sup> <https://www.washingtonpost.com/nation/2020/08/23/coronavirus-covid-updates/>

<sup>5</sup> <https://www.medrxiv.org/content/10.1101/2020.08.07.20170555v1>

<sup>6</sup> Ibid.

<sup>7</sup> <https://apnews.com/2b305e6af052e6fe1d4bc247804ef569>

<sup>8</sup> <https://www.usatoday.com/story/travel/hotels/2020/09/14/california-oregon-wildfires-hotels-shelter-evacuees-amid-covid-19/5790454002/>

<sup>9</sup> <https://www.klcc.org/post/one-person-tests-positive-covid-19-linn-county-evacuation-center>

<sup>10</sup> <https://www.seattletimes.com/seattle-news/2-people-test-positive-for-covid-19-after-staying-at-king-county-clean-air-shelter/>

<sup>11</sup> <https://www.nature.com/articles/s41558-020-0790-4>

<sup>12</sup> Ibid.

This season of extreme weather coupled with the pandemic has created a new class of cascading risks, whereby one hazard leads to another and so on.<sup>13</sup> In the Midwest, communities had flooding evacuation as well as stay-at-home orders.<sup>14</sup> Likewise, in the South, people have had to navigate between hurricane evacuation and shelter-in-place orders. For many coastal states in the Gulf South, only moderate COVID-19 restrictions were imposed in April and May, which was followed by premature re-openings across the region. This area has been experiencing a severe, hyperactive hurricane season while the state of Louisiana has become a national hotspot of COVID-19 mortality, in part due to a legacy of racial discrimination and underinvestment in healthcare.<sup>15</sup> The collision of extreme weather events, racial injustice, and COVID-19 presents new challenges for emergency managers and the public alike.

There is also a domino-effect when it comes to the interplay of some extreme weather and COVID-19. COVID-19 has exacerbated excessive heat risks in the Southwest United States – traditionally, people seek respite from the heat at public cooling centers, such as libraries, municipal buildings, splash pads, and more. Due to the pandemic, many of these places are closed, leading to more instances of heat exhaustion or stroke, which can result in death.<sup>16</sup> With an uptick in cases of heat illness, hospitals and emergency services face additional strain in the midst of an already-strained healthcare system.<sup>17</sup>

Ongoing wildfires in the West are also intersecting with COVID-19 as well as climate change. Extreme heat has increased in frequency and severity due to climate change, leading to a “scorching summer” along the West Coast that created unprecedented dry conditions.<sup>18</sup> The pandemic has disrupted wildfire prevention measures and firefighter training programs, which increased the risks from these dry conditions and laid the groundwork for the biggest wildfires ever recorded this season.<sup>19</sup>

Devastating wildfires in Oregon have led to cascading risks: incoming rain storms could cause landslides, flooding, and lightening to burn areas across the region.<sup>20</sup> Vegetation that normally holds soil in place has turned to ash, raising the risk of extremely dangerous landslides.<sup>21</sup> Thousands have already been forced to evacuate in the state, and these additional extreme weather threats may prolong the time people have to remain at shelters, raising fears over the spread of COVID-19 in these shelters.

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<sup>13</sup> Ibid.

<sup>14</sup> Dahl, K. A. Continued social distancing critical for U. S. regions where flooding and COVID-19 are set to collide. *Union of Concerned Scientists* <https://blog.ucsusa.org/kristy-dahl/continued-social-distancing-critical-for-us-regions-where-flooding-and-covid-19-are-set-to-collide> (2020).

<sup>15</sup> <https://www.nature.com/articles/s41558-020-0804-2>

<sup>16</sup>

[https://www.eenews.net/climatewire/2020/09/09/stories/1063713163?utm\\_campaign=edition%2BiZ%2B%2FfFV%2B2LxUfHtN5bxJQ%3D%3D&utm\\_medium=email&utm\\_source=eenews%3Aclimatewire](https://www.eenews.net/climatewire/2020/09/09/stories/1063713163?utm_campaign=edition%2BiZ%2B%2FfFV%2B2LxUfHtN5bxJQ%3D%3D&utm_medium=email&utm_source=eenews%3Aclimatewire)

<sup>17</sup> Phillips, C.A., Caldas, A., Cleetus, R. *et al.* Compound climate risks in the COVID-19 pandemic. *Nat. Clim. Chang.* **10**, 586–588 (2020). <https://doi.org/10.1038/s41558-020-0804-2>

<sup>18</sup> <https://www.nytimes.com/2020/09/11/us/wildfires-live-updates.html>

<sup>19</sup> Groom, N. Trump administration halts wildfire prevention tool in California over coronavirus. *Reuters* <https://www.reuters.com/article/us-health-coronavirus-usa-wildfires/trump-administration-halts-wildfire-prevention-tool-in-california-over-coronavirus-idUSKCN21X1HD> (2020).

<sup>20</sup> <https://www.opb.org/article/2020/09/17/wildfires-oregon-news-updates/>

<sup>21</sup> Ibid.

## Environmental Justice: Inequities in Disaster Preparedness and Response

Research has demonstrated that climate hazards and COVID-19 “will exacerbate and be exacerbated by the unfolding economic crisis and long-standing socioeconomic and racial disparities...in ways that will put specific populations at heightened risks and compromise recovery.”<sup>22</sup> Climate change has intensified these hazards, causing more frequent and severe weather events that harm vulnerable populations the most.<sup>23</sup>

This Committee’s July 14, 2020 hearing on environmental justice, extreme heat, and COVID-19 found that extreme heat disproportionately impacts communities of color, low-income communities, those with pre-existing conditions, and other vulnerable populations, largely due to redlining and racist housing practices.<sup>24</sup> The Gulf Coast region has already faced numerous catastrophic hurricanes this season, in addition to being a COVID-19 hotspot in part as a result of a legacy of racial discrimination and lack of access to quality healthcare.<sup>25</sup> These communities face unique risks from the compounding nature of climate disasters and COVID-19. For those who are displaced by extreme weather events, many find themselves in situations that do not allow for social distancing and without access to proper healthcare. They face many immediate risks, such as contracting COVID-19, but there are also many long-term physical and mental health effects that require further study including the psychological impacts of being displaced, losing one’s home or a loved one from the disaster or the disease, the increased risk of contracting COVID-19, and more.

Disparities in preparedness and response is in and of itself a compounding risk for vulnerable communities facing a natural disaster or disease. Pre-COVID-19, these disparities already existed between communities of color and white communities. For example, Hurricane Katrina revealed the racial inequities that already existed in New Orleans and how the government’s failure to organize evacuation plans harmed communities of color and the poor leading up to the storm.<sup>26</sup> In the storm’s aftermath, the weak and slow Federal response compounded these existing inequalities that persist to this day. With the Federal Emergency Management Agency (FEMA) in charge of both coordinating the nation’s response to COVID-19 as well as any response to extreme weather and climate disasters, the already-overburdened agency’s resources are stretched even thinner, raising concerns over the allocation of those limited resources both pre and post-disaster.<sup>27</sup>

## **Risk Communication**

### Media Exposure and Trusted Sources

Online media has largely overtaken local news reports and disaster reports from official sources as the main information source for people in a storm’s path.<sup>28</sup> Research on the public health

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<sup>22</sup> <https://www.nature.com/articles/s41558-020-0804-2>

<sup>23</sup> Phillips et al. 2020. “Compound climate risks in the COVID-19 pandemic.” *Nature Climate Change*.

<https://www.nature.com/articles/s41558-020-0804-2>

<sup>24</sup> <https://docs.house.gov/meetings/SY/SY00/20200714/110903/HHRG-116-SY00-20200714-SD002.pdf>

<sup>25</sup> <https://www.nature.com/articles/s41558-020-0804-2>

<sup>26</sup> <https://www.arcgis.com/apps/Cascade/index.html?appid=2106693b39454f0eb0abc5c2ddf9ce40>

<sup>27</sup> <https://www.nature.com/articles/s41558-020-0804-2>

<sup>28</sup> Thompson RR, Holman EA, Silver RC. Media Coverage, Forecasted Posttraumatic Stress Symptoms, and Psychological Responses Before and After an Approaching Hurricane [published correction appears in *JAMA Netw Open*. 2019 Jan 4;2(1):e190011]. *JAMA Netw Open*. 2019;2(1):e186228. Published 2019 Jan 4. doi:10.1001/jamanetworkopen.2018.6228

impacts of media exposure to various crises, from epidemics to terrorist attacks, has revealed that repeated media exposure “can lead to increased anxiety, heightened stress responses,” which can have long-term physical and mental health consequences.<sup>29</sup> Heightened stress can lead to disproportionate responses to the crisis at hand, such as panic buying of items like toilet paper and hand sanitizer, as we have seen with COVID-19.

The 24/7 media cycle can have a detrimental effect on people’s threat perception, causing increased distress, worry, and impaired functioning even if the risk is relatively low to them. This can create a “cycle of distress,” whereby people with the greatest concerns may watch more media coverage of the event or risk, which leads them to stress more.<sup>30</sup> When facts about risks are known and properly communicated to the public through the media, people generally form accurate perceptions of the given risk. However, without accurate and effective communication, people tend to form overestimated assessments of the threat, which leads to unnecessary stress and disproportionate behavioral responses.<sup>31</sup> For example, the 2014 Ebola crisis was given unprecedented media attention in the United States even though there was a low risk of transmission of the disease.<sup>32</sup> This media coverage of the Ebola crisis was found to be associated with “negative psychological outcomes, even among individuals at low risk for contracting the disease.”<sup>33</sup> These findings offer insight into the psychological impacts of COVID-19 media exposure, which is likely to be worsened by the fact that disease transmission risks are higher for COVID-19, and coverage of this crisis has persisted for longer than the Ebola crisis.

#### Gaps in Understanding

There remains much uncertainty about effective risk communication during a public health crisis especially around the use of social media.<sup>34</sup> Further research is needed to better understand social media as a source of risk communication, including how federal agencies can better leverage this medium to disseminate information. At present, emergency management agencies tend to underutilize social media as a communication source, thus further research could inform and advance their use of this tool.<sup>35</sup>

Another area in need of additional research is risk communication and disaster planning with vulnerable communities. The elderly, people of color, the disabled, non-English speaking people, children, those with chronic medical diseases, and other vulnerable populations must be able to access information that is actionable to them to plan for a disaster. Many Americans lack the social and economic resources to protect themselves during disasters.<sup>36</sup> Some lack access to disaster information or seek it out from sources outside official governmental channels. Effective disaster communication and planning must ensure that all individuals have equal and sufficient access to information about how to best prepare given their circumstances.<sup>37</sup> Emergency

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<sup>29</sup> Garfin, D. R., Silver, R. C., & Holman, E. A. (2020). The novel coronavirus (COVID-2019) outbreak: Amplification of public health consequences by media exposure. *Health Psychology, 39*(5), 355-357. <http://dx.doi.org/10.1037/hea0000875>

<sup>30</sup> Ibid.

<sup>31</sup> Ibid.

<sup>32</sup> <https://journals.sagepub.com/doi/full/10.1177/2167702617692030>

<sup>33</sup> <https://journals.sagepub.com/doi/full/10.1177/2167702617692030>

<sup>34</sup> Garfin, D. R., Silver, R. C., & Holman, E. A. (2020). The novel coronavirus (COVID-2019) outbreak: Amplification of public health consequences by media exposure. *Health Psychology, 39*(5), 355-357. <http://dx.doi.org/10.1037/hea0000875>

<sup>35</sup> Ibid.

<sup>36</sup> <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1855003/>

<sup>37</sup> <https://aspe.hhs.gov/system/files/pdf/75866/emergfrA.pdf>

managers must take into account risk perception and communication when disseminating emergency information and organizing evacuations. Little is known about risk perception when it comes to vulnerable populations and emergency preparedness.<sup>38</sup> Previous disasters, such as Hurricane Katrina in 2005 and Hurricane Maria in 2017, emphasized that the needs of these groups continue to be inadequately understood and addressed by traditional emergency plans, and highlight that further research must be done to better equip these communities before, during, and after an emergency.

## **Social and Behavioral Science**

### Emergency Management Research

On September 26, 2019, this Committee held a hearing titled *Understanding, Forecasting, and Communicating Extreme Weather in a Changing Climate*, which discussed the challenges of communicating uncertainty and understanding the societal impacts of extreme weather.<sup>39</sup> The hearing explored the ongoing issue of communicating extreme weather forecasts for local, state, and federal officials, and underscored the need for more social and behavioral science research to understand how people interpret and respond to weather warnings.<sup>40</sup> This need has become even more urgent as the pandemic has added huge complexities in preparing for and responding to extreme weather.

Federal emergency response tends to prioritize evacuation from hurricane and wildfire zones, while state and local authorities are left to deal with preventing the spread of and containing any resulting increases COVID-19 cases. Better coordination is needed at every level of government “to prevent potential conflicts of strategy across agencies, sectors, and scales.”<sup>41</sup> To improve this coordination, additional interdisciplinary, cross-sectoral risk assessments and research is needed in the emergency management domain. Assessments such as the National Climate Assessment tend to be siloed from public health and must consider spatial and temporal intersection of physical hazards and health or socioeconomic risk factors, interdependencies between sectors, and potential feedback mechanisms.<sup>42</sup>

In addition, the United States’ conventional emergency response framework places an emphasis on disaster response as opposed to pre-disaster preparedness. To shift the modus operandi to be preventative, further research and resources are needed to bolster understanding of how the US emergency management apparatus can better prepare communities for individual and compounding disasters. This is especially poignant in the era of COVID-19, when emergency response agencies and first responders are particularly likely to find themselves deployed across multiple crises at the same time, putting them under unprecedented strain.

### Climate Change and Health Research

Health impacts from the changing climate include increased sickness due to worsening extreme heat, increased vector-borne infectious diseases, and a range of diseases due to worsening air

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<sup>38</sup> <https://aspe.hhs.gov/system/files/pdf/75866/emergfrA.pdf>

<sup>39</sup> <https://docs.house.gov/meetings/SY/SY00/20190926/109982/HHRG-116-SY00-20190926-SD001.pdf>

<sup>40</sup> Ibid.

<sup>41</sup> Phillips, C.A., Caldas, A., Cleetus, R. *et al.* Compound climate risks in the COVID-19 pandemic. *Nat. Clim. Chang.* **10**, 586–588 (2020). <https://doi.org/10.1038/s41558-020-0804-2>

<sup>42</sup> Ibid.

quality. Climate change poses the greatest threat to communities that have historically faced underinvestment and systemic inequality, such as communities of color and low-income communities.<sup>43</sup> These communities are already disproportionately exposed to extreme heat and other environmental hazards and lack resources to adapt to climate change. Other populations of concern are children, the elderly, people with chronic medical conditions, and vulnerable occupational groups, such as outdoor workers.<sup>44</sup> As the pandemic progresses, researchers are beginning to pose questions about how compound climate hazards intersect with the pandemic and associated public health response.<sup>45</sup>

### The COVID-19 Pandemic, Extreme Weather, And Mental Health

In addition to, and in connection with, associated physical harms, researchers have demonstrated that climate change also impacts mental health.<sup>46</sup> Survivors of natural disasters experience more harms to mental health, including increased post-traumatic stress disorder, depression, anxiety, substance abuse, and domestic violence.<sup>47</sup> Children in particular demonstrate strong psychological impacts from extreme events; childhood trauma can last into adulthood, and children's bodies are more vulnerable than adults' to the physical effects of heat. Children are also more reliant on social networks that are disrupted by climate-driven events.<sup>48</sup> Beyond climate-driven extreme weather events, evidence for climate anxiety, or anxiety associated with perception of climate change, is emerging in the literature.<sup>49</sup> It is important, however, to differentiate between adaptive and maladaptive responses. Anxiety can serve an adaptive function in response to real threats and is not necessarily pathological.<sup>50</sup>

Similarly, as the pandemic unfolds, researchers are beginning to discuss and study the mental health implications of the pandemic.<sup>51</sup> For example, populations experiencing financial impacts such as lower income and limited savings are experiencing greater depression during COVID-19.<sup>52</sup> Experts have described the COVID-19 pandemic as a "perfect storm" for the mental health of young people in particular.<sup>53</sup> These researchers point to extended home confinement, grief, increased exposure to domestic violence, and the impact of social media as factors that may make adolescents vulnerable during the pandemic.<sup>54</sup> Researchers are also investigating mental health impacts from the pandemic on other vulnerable populations, such as communities of color and people in prisons and other types of detention.<sup>55,56</sup> These discussions and early results in

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<sup>43</sup> Chalupka, S., Anderko, L., & Pennea, E. (2020). Climate change, climate justice, and children's mental health: A generation at risk? *Environmental Justice*, 13(1), 10-14. doi:10.1089/env.2019.0034

<sup>44</sup> <https://health2016.globalchange.gov/populations-concern>

<sup>45</sup> Phillips, C.A., Caldas, A., Cleetus, R. *et al.* Compound climate risks in the COVID-19 pandemic. *Nat. Clim. Chang.* 10, 586–588 (2020). <https://doi.org/10.1038/s41558-020-0804-2>

<sup>46</sup> Clayton, S. (2020). Climate anxiety: Psychological responses to climate change. *Journal of Anxiety Disorders*, 74, 102263. Doi: <https://doi.org/10.1016/j.janxdis.2020.102263>

<sup>47</sup> Similarly, heat increases aggression and conflict, and increased suicide and hospitalization for mental health problems. Poor air quality is associated with cognitive impairment in the elderly, and behavioral changes in children.

<sup>48</sup> Ibid.

<sup>49</sup> Ibid.

<sup>50</sup> Ibid.

<sup>51</sup> <https://academic.oup.com/aje/advance-article/doi/10.1093/aje/kwaa147/5874602>

<sup>52</sup> <https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2770146?resultClick=1>

<sup>53</sup> Danese, A., & Smith, P. (2020). Debate: Recognising and responding to the mental health needs of young people in the era of COVID-19. *Child and Adolescent Mental Health*, 25(3), 169-170. doi:10.1111/camh.12414

<sup>54</sup> <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7323662/>

<sup>55</sup> <https://pubmed.ncbi.nlm.nih.gov/32525370/>

<sup>56</sup> <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7147918/>

how the current crisis affects mental health build upon an established body of evidence from previous epidemics, extreme weather events, and other crises.<sup>57,58,59,60,61</sup> A few studies have looked at the impact of multiple, compounding societal crises on mental health, but more research needs to be done to understand how compound and cascading risks interact with psychological well-being.<sup>62</sup>

### Federal Funding and Research Gaps

The societal impacts of natural and man-made disasters are complex and can vary over the short and long-term, making it important to collect data both immediately after disasters and through sustained, long-term data collection. The NSF RAPID grant mechanism is a program that supports quick-response research. It focuses on proposals of up to \$200,000 on natural or anthropogenic disasters and similar unanticipated events and only requires internal merit review;<sup>63</sup> RAPID grants have been used previously to award research grants during the Zika and Ebola outbreaks.<sup>64</sup> NSF has several mechanisms that have been used to study social and behavioral dynamics in the years after disasters; however grant awards are typically not longer than four years. This research has also been funded through previous Disaster Supplemental Appropriations. Currently, NSF has a dedicated COVID-19 website that outlines funding opportunities related to the pandemic.<sup>65</sup> A recent literature review noted that there is more research on short-term social consequences of disasters, but few longitudinal studies, leaving a large gap in our understanding of how immediate impacts bear out long term, and clearly underscoring the need for additional research funding to support these studies.<sup>66</sup>

A growing body of research discusses the health impacts of a changing climate, but significant gaps remain.<sup>67</sup> Part of the problem is that federal funding is negligible in this space. For example, just 0.17% of NIH's budget in 2008 went to climate-focused proposals. In addition to this, there are limited career opportunities for students interested in the intersection of climate change and health.<sup>68</sup> Established researchers in this field have called for increased funding and dedicated research programs to address the health risks of climate change, with increased

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<sup>57</sup> <https://www.pnas.org/content/117/23/12595>

<sup>58</sup> An, R., Qiu, Y., Xiang, X., Ji, M., & Guan, C. (2019). Impact of Hurricane Katrina on mental health among US adults. *American Journal of Health Behavior*, 43(6), 1186-1199. doi:10.5993/AJHB.43.6.15

<sup>59</sup> Fullerton, C. S., Mash, H. B. H., Wang, L., Morganstein, J. C., & Ursano, R. J. (2019). Posttraumatic stress disorder and mental distress following the 2004 and 2005 Florida hurricanes. *Disaster Medicine and Public Health Preparedness*, 13(1), 44-52. doi:10.1017/dmp.2018.153

<sup>60</sup> Heid, A. R., Pruchno, R., Cartwright, F. P., & Wilson-Genderson, M. (2017). Exposure to hurricane sandy, neighborhood collective efficacy, and post-traumatic stress symptoms in older adults. *Aging & Mental Health*, 21(7), 742-750. doi:10.1080/13607863.2016.1154016

<sup>61</sup> Raker, E. J., Lowe, S. R., Arcaya, M. C., Johnson, S. T., Rhodes, J., & Waters, M. C. (2019). Twelve years later: The long-term mental health consequences of Hurricane Katrina. *Social Science & Medicine*, 242, 112610. doi:10.1016/j.socscimed.2019.112610

<sup>62</sup> Gargano, L. M., Li, J., Millien, L., Alper, H., & Brackbill, R. M. (2019). Exposure to multiple disasters: The long-term effect of hurricane sandy (October 29, 2012) on NYC survivors of the September 11, 2001 world trade center attack. *Psychiatry Research*, 273, 719-724. doi:10.1016/j.psychres.2019.01.090

<sup>63</sup> [https://www.nsf.gov/pubs/policydocs/pappg19\\_1/pappg\\_2.jsp#IIE1](https://www.nsf.gov/pubs/policydocs/pappg19_1/pappg_2.jsp#IIE1).

<sup>64</sup> See NSF, "Dear Colleague Letter on the Coronavirus Disease 2019 (COVID-19)," NSF 20-052, April 3, 2020, <https://www.nsf.gov/pubs/2020/nsf20052/nsf20052.jsp>.

<sup>65</sup> [https://www.nsf.gov/news/special\\_reports/coronavirus/](https://www.nsf.gov/news/special_reports/coronavirus/).

<sup>66</sup> <https://www.annualreviews.org/doi/abs/10.1146/annurev-soc-121919-054827>

<sup>67</sup> <https://health2016.globalchange.gov/>

<sup>68</sup> <https://www.mdpi.com/1660-4601/17/4/1310/htm>

coordination and planning among agencies like EPA, NIH, CDC, NOAA, and NSF.<sup>69</sup> They estimate that over \$200 million annually dedicated to research on the health impacts of climate change is required to meet the current needs.

Researchers have also called for more long-term funding that encourages interdisciplinary approaches to the topics of natural disasters and other crises, including an integration of traditionally siloed fields like emergency management, public health, and economics.<sup>70</sup> In order to respond effectively to the pandemic, social and behavioral science research is needed to better understand current behavioral responses and inform decisions across the country that increase trust and encourage scientifically-informed action to mitigate risks.<sup>70</sup>

### **Additional Reading**

Dan Walton and Maarten van Aalst, September 2020. “Climate-related extreme weather events and COVID-19: A first look at the number of people affected by intersecting disasters.”  
<https://media.ifrc.org/ifrc/wp-content/uploads/sites/5/2020/09/Extreme-weather-events-and-COVID-19-V4.pdf>

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<sup>69</sup> <https://ehp.niehs.nih.gov/doi/full/10.1289/ehp.0800088>

<sup>70</sup> <https://www.scientificamerican.com/article/what-happens-when-other-disasters-hit-during-a-pandemic/>